CNC MACHINE

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Cover and TOC photos by Joe Maggiore

THE MASTHEAD

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in this ISSUE

White Knights? Virgins? Probing? Confessions? What's it all mean?

No, it's not what you think. We're not stooping to sex as a means to catch your attention. Well, okay, maybe we are. But the reality is, each of these things shares a common thread with regard to this issue of *CNC Machining*. In a word, that thread is precision. In several words, it is precision, accuracy and attention to detail, which, in turn, leads to better, faster and cheaper.

Our cover story this issue is about a company in Michigan that goes by the name White Knight. The name derives from the fact that they work almost exclusively in Teflon® . . . *virgin* Teflon. From solid blocks of the stark, white material, White Knight manufactures fluid pumps that are used in the microchip industry. They have developed some very precise machining techniques to manufacture pumps that are completely devoid of metal.

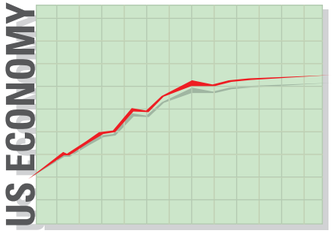
Such precision is aided by the accuracy of the Haas machines White Knight uses to machine the Teflon, which leads us to our story on probing. We take you inside Haas Automation for a look at the calibration and validation techniques Haas uses to produce high-quality machine tools faster, better and cheaper than the competition. It's an approach that can be applied by any shop looking to increase accuracy in their own facility.

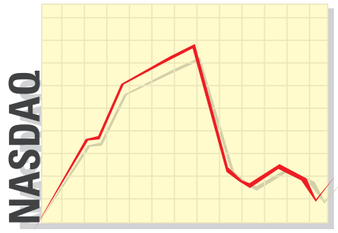
Whether the job involves machining, proofreading or the written word, it's all about attention to detail. Accuracy takes many forms. In our piece *Confessions of a Machine Shop Neophyte*, our very own proofreader donned steel-toed boots and traded in her computer for a machine tool for a week of hands-on experience in the machine shop. We think you'll find her exploits interesting.

And there's more. Our European Correspondent Matt Bailey attended the official grand opening of Haas Automation Europe and gives us a full report. There's a very informative piece about integrating PC-based solid modeling programs with CAM packages to help shops increase business and reduce costs. And we visited a local technical college for a look at how Haas machines are helping students prepare for today's industry.

It's another great issue, so sit back, relax and enjoy!

Manufacturing:
~~The New~~ . . . ~~The Old~~ . . . The New Economy





Are we depressed yet? The stock market has dropped like a stone, the economy is tanking, etc., etc. I'm getting to the point where I don't even want to watch the news or read a magazine anymore. Either everything is fantastic – we're in a new economy and we manufacturers are "has beens" – or the world as we know it is coming to an end. When the media carry on like they do, it makes it very difficult to keep a civil thought about anything in the world. Personally, I am tired of the gross exaggerations in both directions.

In an attempt to do some independent (rational) analysis of the current economic situation, I have spoken with a number of manufacturers (our customers), distributors, vendors and people who actually make things for a living. While some industries are struggling, not all of manufacturing has gone to heck in a hand basket. Indeed, there are troubled spots in the U.S. – and in the world – but we shouldn't all jump off of a bridge because of them.

Even with recent announcements of layoffs, U.S. unemployment is still running below 5% in most areas. At the same time, Europe's double digit unemployment figures are trending downward, and in most other countries, unemployment is back to single digits. South America is strengthening, and though Southeast Asia continues to vary by country, as a region, it is steady overall. Fallout from the past decade still affects the financial sectors of the world, however, with the Japanese and Korean banking structures being the most precarious at this time.

But economic growth in the U.S. continues – albeit at lower levels than we've become used to. Coming on the heels of the sustained high growth of the past few years, however, the current 1% to 2% growth in the economy feels like a recession, when, in fact, it is still growth.

The stock market stopped being a good indicator of economic health when the NASDAQ was taken over by emotion. The bidding up of stocks in companies with no profits (actually huge losses and high burn rates of the capital raised by selling their stocks) and P.E. ratios that were described as 'not relevant' were a speculators' panacea. When reality set in, the NASDAQ returned to realistic levels. Unfortunately, it took down with it some companies that actually make and sell products (such as Intel), as opposed to all the "vapor ware" companies whose stocks soared based solely on emotion.

With all of these events, and despite record deficits, the U.S. dollar continues to climb in value. Therefore, imports are less expensive, and companies who export goods are fighting price wars that they cannot win. This is causing some manufacturing sectors to struggle, with little ability to affect the outcome. One company alone cannot affect the value of the U.S. dollar.

Where does this leave us? I believe the economy will continue to see slow growth because of certain industries. Some industries will see a shrinking from the past few years, but, overall, will continue to manufacture and sell their products around the world. There will still be some 15 million automobiles sold in this country this year; and while that is down from the record paces of the past two years, it would have been a record 5 years ago. The oil patch and related industries will continue to be healthy due to the current price of oil, and medical industries will continue to see high growth. After a number of years of retrenching, the aerospace industry will mount a strong comeback, but the technology sector will continue to struggle after having increased to over capacity too quickly.

What does all this mean to you, the manufacturers of the world? The world is not coming to an end. We will continue to struggle with over capacity and weak pricing for this year, but we should use this as an opportunity to continue our productivity gains through modernization in order to compete in the world economy. We are not dead, dying or even sick. We are back as the new/old/new economy. And while we may not be popular with the news people, we are the backbone of our nations, and we will continue to be as long as we manufacture the products that everyone in the world needs and takes for granted every day.

Mini Mill Hits 1,000 Mark

In today's disposable society, where many consumer goods are produced by the million, selling a mere thousand units of any one product in a single year is no big deal. But in the world of machine tools, it's almost unheard of. In fact, more than 90% of the world's machine tool builders don't even ship that many units per year of their entire product line combined, let alone of one specific model.

Haas Automation, however, rolled its 1,000th Mini Mill off the production line in April, just a year after the machine's introduction. Since its debut at WESTEC 2000 in Los Angeles, the small machine with big capabilities has been a runaway success. With a 6.5' x 6.5' footprint, 16" x 12" x 10" travels and full CNC capabilities, demand for the Mini Mill has been brisk, to say the least. In the first month of production, five machines rolled off the assembly line; by the sixth month, that number had risen to 120 machines – and production will likely double by the end of this year.

Conceived as both an affordable first CNC machine for smaller shops and a second-op machine for larger ones, the Mini Mill began as a rough sketch by Gene Haas in early summer 1999. By late August of that year a list of specifications had been developed, followed shortly by a CAD drawing. Construction of the prototype machine began during the winter, and in April 2000, following WESTEC, production began in earnest. With only a couple minor design changes early on (to improve chip clean-out and coolant circulation), the Mini Mill has proved to be one of the most popular machines in Haas history.

Given its reliability and the quality of the parts it cuts – and, of course, the unheard-of $29,999 price – many customers order second and third machines. Yet another advantage is that the Mini Mill is easy to move. It's not hard to see why orders of nearly 100 machines a month have been the norm: in short, customers love 'em.

The recent addition of the new Super Mini Mill to the Haas product line – a high-speed Mini Mill with 15,000-rpm spindle, 1,200-ipm rapids, High-Speed Machining software, 16 MB of RAM and high-speed tool changer – will surely keep demand for the diminutive machines high.

TRADE SHOW CALENDAR

For additional information go to www.HaasCNC.com/news/trade_show.html

Date	Show Name/Location	Booth #
May 8-10	Rocky Mountain Industrial & Machine Tool Show The Denver Merchandise Mart, Denver, CO	Booth 1100
May 8-10	Northern California/Silicon Valley Machine Tool Show Santa Clara Convention Center, Santa Clara, CA	Booth 218
May 22-24	EASTEC Eastern States Exposition Grounds, West Springfield, MA	Booth 1420
May 22-24	GSA EXPO 2001 Orange County Convention Center, Orlando, FL	Booth 4087

The Loss of a Legend

The season started off normally enough; in fact, pretty much status quo. The same race teams were vying for the same championships on the same tracks, with pretty much the same drivers. Sure, there were a few new faces, and Dodge was back in NASCAR after an 18-year hiatus, but for the most part, it was racing as usual.

But it all changed in the blink of an eye. As the clock ticked down on the final seconds of the Daytona 500, NASCAR legend Dale Earnhardt was lined up behind Michael Waltrip and Dale Earnhardt Jr., the drivers for his own newly formed team, as they rounded the third turn of the final lap of the race. It looked for all the world like Team Earnhardt and its owner were headed for a dramatic 1-2-3 finish. Dale was probably the happiest man on the track.

Then came the unthinkable.

As Dale pulled in front of the pack high on the banking of turn three, the rear end of his #3 Chevrolet broke loose. Everything seemed to move in slow motion as the car slid sideways. Earnhardt struck the wall practically head-on at nearly 180 miles per hour and was struck by Ken Schrader's Chevrolet. Both cars spun down off the banking as Michael Waltrip took the checkered flag.

It didn't *look* that bad. It looked like just another routine accident – one from which Dale would emerge grinning and waving to the crowd, perhaps a bit shaken and embarrassed by his bad luck, but thrilled by his team's victory.

But it *was* that bad. Track medical personnel had to cut Earnhardt from his black No. 3 Chevrolet before he could be transported to nearby Halifax Medical Center. All efforts to revive the NASCAR legend failed. Medical reports reveal that he died instantly upon impact with the wall.

Dale Earnhardt Sr. never got to celebrate his team's victory. When it came to the final race of life, "The Intimidator" could not sway the powers that be.

Haas Automation offers its sincere condolences to Dale's family and friends for their loss. He will be sorely missed.

The loss of Dale Earnhardt is a grim reminder of what the racing community knows all too well: Racing is a risky business. In their quest for victory, drivers constantly walk a fine line between safety and disaster. As speeds increase, so do the risks. The slightest mistake or smallest component failure can result in the destruction of an expensive race car – or worse, in the loss of life.

Drivers take these risks willingly, but not recklessly. Race teams are well aware that much more than victory is on the line every time a car hits the track. They use the finest materials, the latest technology and modern machine tools to ensure their cars and engines are not only fast, but reliable and safe.

Haas is proud to be a part of this quest for faster and safer racing by providing the latest CNC equipment to the following race teams through a series of technical partnerships.

NASCAR

Hendrick Motorsports driver Jeff Gordon (#24) seems to be back on track this year after a disappointing season in 2000. With eight races of the 36-race series under his belt, Gordon is sitting in second place behind Dale Jarrett in the points standings. He has already amassed one win (Las Vegas) and three pole positions. Hendrick teammates Terry Labonte (#5) and Jerry Nadeau (#25) are sitting in 15th and 18th position respectively.

PPI Motorsports drivers Ricky Craven (#32) and Andy Houston (#96) are back in the pack at 24th and 42nd place, respectively, with Craven logging one top-five finish so far.

NASCAR Truck

Hendrick Motorsports rookie Ricky Hendrick (#17) and veteran Jack Sprague (#24) are currently ranked 4th and 5th, respectively, in the Craftsman series, with both having collected 472 points after four of 24 races.

CART Champ Cars

With only two of 21 races out of the way, it's too soon to tell how the season will shape up for PacWest Racing Group. Rookie Scott Dixon (#18), who fills the seat vacated by Mark Blundell, is still getting the feel for the Champ car. Dixon won the Indy Lights series in 2000, and currently is ranked 18th in Champ points. Mauricio Gugelmin (#17) currently sits in 22nd place.

NHRA

Haas welcomes J&B Motorsports to its family of technical partnerships for the 2001 drag race season. J&B will be carrying the Haas logo down the strip in the NHRA Federal-Mogul Funny Car series.

C&C Motorsports

Haas and C&C team up again in 2001 for another year of competition in SCRA Sprint Car racing, SCORE off-road truck racing and NASCAR Winston West racing. Expect to see drivers Troy Cline and Joe Custer keeping the Haas name out in front.

Story and photos by Matt Bailey

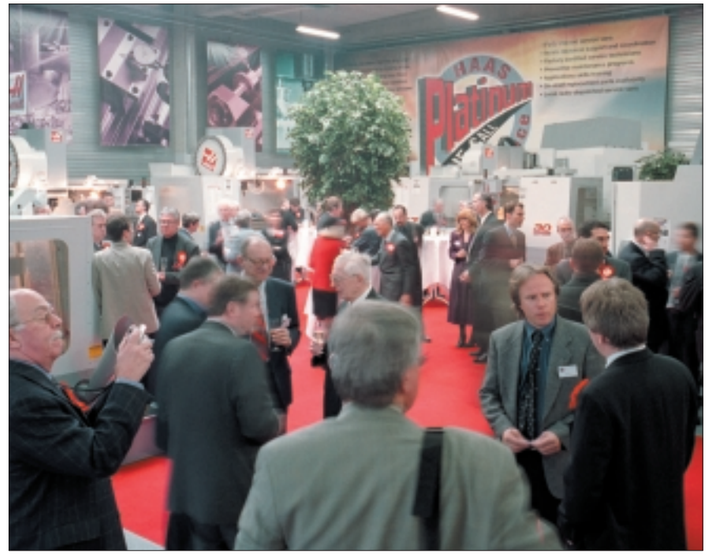
A *Grand* Opening in Brussels – Haas Automation Europe

For all of its cultural charms, I can assure you, there are few places in the world as grey and overcast as northern Europe in the middle of February.

This February, however, saw a splash of California colour alight upon and make its home in an industrial estate a few miles south of the Belgian city of Brussels. The colour in question, of course, is the red that has become synonymous with the makers of world-beating CNC machine tools. The occasion was the official opening of Haas Automation Europe.

While the visiting California contingent battled the bone-chilling cold and jet lag, the staff of the company's new, wholly owned European subsidiary radiated pride as they welcomed a deluge of guests to the opening of their new sales and support facility.

In an elegant, thriving city more famous for fine chocolate candy and European legislature than for CNC machines and state-of-the-art manufacturing technology, February 20 marked the beginning of a new era for Haas Automation. Watched by the European press, Gene Haas ceremoniously cut the obligatory red ribbon and initiated this vitally important next phase in the company's expansion program. A multilingual welcoming speech by Brussels Region Foreign Minister Mr. Guy Vanhengel gave proceedings the official seal, and a few words by Haas Automation Europe's newly appointed Managing Director, Dr. Ing. Theo Leon, rounded off the formalities.



The European trade press mingles with customers and Haas representatives during the official grand opening of Haas Automation Europe's showroom and support facility in Brussels.

The applause died down and machining demonstrations shattered the quiet. Operators put the 14 or so Haas machines through their paces until a fine mist of vaporized coolant rose up, past the spindle housings and toward the high ceilings. After a short while, the showroom looked and sounded just like a bustling, Haas-dominated working machine shop typical of the many found all over America – albeit with carpets and potted plants.

Lunchtime drew near and editors from Europe's manufacturing and machine tool publications joined Mr. Haas, Dr. Ing. Leon and Haas Automation management from both sides of the Atlantic for a buffet and a toast to the new venture.

The purpose-built European showroom and support facility is based at Paepsem Business Park, 15 minutes from the city centre and within easy reach of Brussels International Airport. With a total area of 12,000 square feet, the showroom and office has copious space to demonstrate every size and configuration of Haas machine.

For the two days following the official opening, VIP guests from companies across Europe were invited to inspect the wide range of Haas machines and meet the Haas

Please see EUROPE page 34

Confessions of a Machine Shop Neophyte

by Linda Dorr

Haas Automation did not hire me for my knowledge of machine tools. In fact, before I got here I didn't know what a machine tool was, but fortunately Haas is one of those companies that values ability over credentials. Marketing was looking for someone with editing/proofing/writing skills; they got what they wanted – and I'm still getting a whole new education. Most of my experience was in medical publishing, and while I worked in publications at a university engineering school for a few years, that was a far cry from the world of manufacturing.

I spent much of my first few weeks on the job reading industry publications and Haas brochures, with an unabridged dictionary close at hand. I also spent a lot of time asking questions of Scott Rathburn, a marketing colleague who knows a lot about Haas machines. Rathburn is a gearhead who is fascinated by what these machines do. I'd always been a lot more interested in natural science than technology, but once I saw some of the machines in the Haas demo room in action, I was hooked. I love watching these things cut metal – it's an amazing process.

By the time I'd been here six months, I knew a few things. I probably couldn't have explained what I knew to anyone else, but at least I could proof a marketing piece without asking a dozen questions – usually two or three would do. I had taken the three-day beginners' programming class that Haas offers to customers, as well as the sales class that details machine configurations. I had also acquired a control simulator at my desk (very useful when editing Haas manuals).

"Haas machines are every bit as accurate as we claim they are; the specs I measured didn't vary all day, from the first part to the 53rd."

One of the best things about working at Haas is that the people who have technical knowledge are always willing to explain things to the clueless. John Roth, Director of Manufacturing Engineering, was walking through marketing one day while I was trying to write some text to go with a photo of a tombstone. I didn't know what I was talking about, and Rathburn was away from his desk, so I asked John for help. He took me out on the shop floor and showed me an HS-1RP, demonstrating a pallet change and explaining why using a tombstone to hold work is so useful. Then he said, "You should really get out here and cut some parts." He didn't need to repeat the offer – I reminded him of it every time I saw him, and a few weeks later, off I went to spend a week on the shop floor.

The first couple days in the shop I worked on a VF-2 under the watchful eye of Joyce Davis, the machinist who is the lead for small verticals. The first parts I cut were draw tubes, steel cylinders with a collar on one end, that needed six symmetrical holes drilled in the collar and one shallow slot milled out of the middle of the cylinder. Joyce showed me how to load the part, pointing out that it needed to be flush with the chuck or the holes would be in the wrong places. After we cut the first one, she introduced me to her calipers. Although my high school drafting class was a while ago (it was the first year girls at my school were allowed to take drafting), I remembered how to read a part blueprint. The first draw tube was well within the specs given, so then I only needed to check every fifth one. Haas machines are every bit as accurate as we claim they are; the specs I measured didn't vary all day, from the first part to the 53rd.

photos by Scott Rathburn

Working on a horizontal was far more physically challenging than being on either a vertical mill or a lathe.

About midday Joyce needed to use the machine I was on, so she moved me to a neighboring VF-2 and had me engrave part numbers on and put saw cuts into the face of a bunch of aluminum pulleys. Once I got the loading sequence down – the saw cuts were done using a 4th axis, and then the part was flipped over and moved to a chuck mounted on the table for engraving – this part was a piece of cake. I wondered why the four grooves cut into its face were randomly placed. When I asked operator Angel Marceleno about this, he took me over to Assembly and showed me where it would be used: in a rotary table. The cuts were just to allow the part to expand and contract, so it didn't matter exactly where they were.

Next up: two days on an SL-20 lathe. I took an instant liking to Henry Arellano, the machinist supervising me, because he reminded me of my oldest nephew: young, big, polite, easygoing and hardworking. Like everyone else, Henry answered my uninformed questions very good-naturedly. The first day was fairly routine, cutting 3-inch liner bar guides (a part for the Haas Servo Bar 300 bar feeder) out of polyurethane. Again, once I learned the loading sequence, it was easy – make sure the part was flush with the chuck, shave the face and half the circumference, then flip it over so the other half of the disk could be cut. The trickiest part of the job was keeping the tool turret and the chuck free of chips. Polyurethane chips take the form of incredibly long strings of plastic ringlets, and they wrap around everything inside the machine. This particular operation didn't require coolant, since polyurethane doesn't heat up the way metal does, and the dry chips were fairly easy to remove. Wet polyurethane, on the other hand (which I dealt with the next afternoon – boring holes does require coolant), was a major pain to untangle. This was the only task that resulted in very minor injuries – for the first hour or so, I kept whacking the back of my hand on various sharp edges on the tool turret. By the time I had three or four spots that were bleeding slightly, I had learned how to untangle the stuff without acquiring any new cuts.

My second day on the lathe was, by Southern California standards, quite cool. I think it had been down in the 40s the night before, and the shop hadn't warmed up much when I arrived, so I was more than happy to help Melinda Gillespie, the lathe operator I would work with that morning, move a batch of what looked like large soup cans. Unlike soup cans, however, these things weighed 12 pounds apiece, so hauling them around took the chill off in a hurry. Then we went to work cutting cylinder tubes out of these solid pieces of steel – the finished product weighed only 3 pounds. Melinda kept having to reload the part, which I had trouble with because it was so heavy. She likes this job because she's learning a lot (she ran manual machines at her last job), and she was happy to pass some of her knowledge on to me.

Measuring the specs on a finished cylinder tube was quite a process. First we used a height gauge, and then a dial bore gauge for the diameter. Then it had to be checked for concentricity, something I had never thought about needing to measure. In fact, I never think about concentricity at all, never mind measuring it – it's just not a concept that ever enters my everyday life. Learning how to measure it was pretty cool, though. You put a dial indicator on the inner wall of the cylinder and then firmly roll the part in place, and if it's concentric the gauge doesn't move.

I spent my last day in the shop working on a horizontal mill (the same HS-1RP that began this story) with machinist Jason Nasta, cutting pocket stops for a 50-taper side-mount tool changer. Working on a horizontal was far more physically challenging than being on either a vertical mill or a lathe. For one thing, I had to reach up, because the parts had to be loaded onto a tombstone that was chest-high. Also, loading and unloading parts on the tombstone required considerably more muscle than I'd been using. Loosening and tightening the clamping bolts was done with a large Allen wrench that had a piece of steel pipe slid over the end to increase leverage.

The first time around, Jason did all the work while I watched and listened. While he made it look effortless, it was quite a workout for me. (I thought, not for the first time, that I really ought to be getting myself to a gym one of these days to learn how to lift weights.) Thanks to that length of steel pipe – leverage is a girl's best friend if she wants to be handy – I could handle loading the pocket stops and loosening the bolts to unload them. Not once, though, did I manage to pry the finished part off the tombstone – the locating pin it was resting on had a much stronger grip than mine. Jason kept saying, "It's not that hard," demonstrating once again the correct way to jiggle the thing loose. I knew better. It *was* that hard – I just don't have the hand and arm strength it requires!

Operating a machine tool requires an amazing amount of attention to detail, something that, despite using the simulator, I didn't fully appreciate until I actually cut parts. In that respect, I'd probably be pretty good at it if I kept it up – I'm definitely detail-oriented. It must take years to learn all the details, though. I kept thinking of the old cliché, "The more I learn, the more I realize how ignorant I am." It's really easy to operate Haas machine tools – the control is pretty much the same on all machines, with minor allowances for the type of machine. Knowing how to operate the machine is a long way from knowing how to set it up, though (or so it seems to me) – and knowing how to set up a job is just the first step in the evolution from operator to machinist. To be an operator, you have to be able to read a blueprint and use measuring tools. To set up a job, you also need – among other things – to be able to read and understand the CNC program (and edit it if necessary), decide what tools are needed for the job, and touch off the tools once they're loaded. Real machinists also understand the relationships between speeds and feeds and the type of metal being cut – an understanding that comes only from experience. And then there's the ultimate test of whether you can call yourself a CNC machinist: Can you write a program that works?

I will probably never call myself a machinist. If I keep learning at my present rate, though, someday I'll be able to flip through the "Application Guidelines" section of the Valenite catalog without feeling intimidated by everything I still don't know!

This article would not have been possible without the help of many people, most of them mentioned on these pages. Thanks, all of you.

The Other Half of the Story

I wasn't a complete stranger to either heavy machinery or physical labor before my week in the machine shop. I grew up in northern New England, with a wood stove, and when my brother, Terry, and I were teenagers we were responsible for stacking the wood. My dad ran a small excavating business, and since he had taught Terry the principles of safe operation of the backhoe, we were allowed to use it. Of course, when our parents weren't home, we didn't just move wood with it. We gave each other rides in the bucket, tested the turning radius and the time to top speed, and so forth. (In case you've never conducted such tests yourself, a backhoe does not turn on a dime, and its motion at top speed is best described as "ponderous.") Thanks to Terry, I even got to drive the dump truck a time or two. So, I knew a little about massive machinery. Very little.

I also knew the week was going to be pretty strenuous, but I still wasn't completely prepared for it. I kept going to bed earlier and earlier as the week went on – working in the shop was far more exhausting than my desk job. I already knew the people "out back" worked hard, but I have a new appreciation for just what their jobs require. I creaked and groaned for nearly another week after my shop stint – several muscles that don't get regular use in marketing weren't very happy about feeling overused. One aspect of the physical workout that was great, though, was that I got to eat like a horse. No counting fat grams that week!

It was kind of fun to note the reactions of other people at Haas – there were a few raised eyebrows in the office areas, where I'm generally seen wearing skirts and hose, not jeans and steel-toed boots (which, although they seemed to weigh 5 pounds apiece, were surprisingly comfortable). And while everyone in the machine shop treated me as if I were entirely capable of operating a machine tool, my marketing coworkers seemed to have their doubts. First it was Rathburn: "You're not cutting any bad parts, are you?" Next it was my boss, Scott Melamed: "Hey, did you tell Pete [Wilson, machine shop supervisor] that if you screw something up, it doesn't count?" Me: "I'm not going to screw anything up!" Melamed: "Well, everyone's worried about you."

Worried about me? This was puzzling, but only for a minute. Then I got it – I'm a known klutz. I'm forever whacking my shins on the corners of my desk, and as for my record with sharp implements . . . well, let's just say I help keep Band-Aid makers in business. I didn't have any major mishaps out in the shop, though. Something about the potential consequences of a machine tool accident seemed to make me more coordinated than usual.

One drawback of working on a machine tool is being sprayed with coolant for much of the day. By Tuesday evening, the skin on my hands was starting to peel in places, and the webs between my fingers had turned white – obviously, it was time to start wearing latex gloves. It was also clear that the thrift-shop sweatshirt I'd picked up for this week wasn't going to last until Friday. On Wednesday morning I decided it could go one more day if I sprayed it with gardenia water – so that's what I did, and went to work smelling faintly of eau de coolant and strongly (I hoped) of gardenias.

I might not have worried about this too much if not for Jerry Sage, the trade show coordinator who works next to me in marketing. When I came back to my desk at the end of my first day in the shop, he said, "Well, you look different." "Yeah," I said, "and I probably smell different, too" (I could smell coolant). This would become Jerry's joke of the week. He actually marched into trade show manager Norine Peters' office and announced, "Linda's back from the shop, and she smells funny." "Well," responded Norine, "that's what happens when you have a real job."

Pete Wilson asked me at the end of the week if I wanted to stay – like every manufacturing company, Haas feels the shortage of machinists and operators. I love the job I already have, though, and I probably don't have the physical stamina to work in the shop full-time for more than a week, so I passed up the offer. What I'd really like is to work out in the shop a few days a month – all in the name of continuing education, of course. And the fact that it was fun.

Precision Partnering

Haas reveals its complete metrology suite used to produce, calibrate and validate high-precision machine tools

Story
courtesy
Renishaw

Photos
Scott
Rathburn

Let's face it, it's a competitive world out there, and the only way to stay in business is to do things better, faster and cheaper than the next guy. Nowhere is this more so than in manufacturing, where escalating material costs, aging equipment, rising utility rates and a continued shortage of skilled labor all combine to tax a company's bottom line.

Haas Automation is a company well known for manufacturing high-quality machine tools better, faster and cheaper than the competition. They currently ship more than 500 CNC machines per month from their facility in Oxnard, California – more than any other U.S. machine tool builder.

To make such production numbers possible, Haas has evolved a battery of advanced calibration and validation techniques that allows them to create machine tools with higher precision, yet lower cost. This same approach offers a great template for Haas customers to use in their own shops, regardless of their size and output.

"The technologies and practices that Haas helped prove out – then aggressively applied to its own manufacturing process control and part validation – can be employed by, and afforded by, any shop," says Barry Rogers, National Sales and Marketing Manager for Renishaw Inc., the U.S. subsidiary company of Renishaw plc, a leading developer of precision metrology products.

Haas and Renishaw have been partners in precision for nearly a decade, finding ways to speed production and increase accuracy of new Haas machines. As in any true partnership, each has benefited from the cross-fertilization of ideas, says Richard Mountan, Haas Production Manager. "However, end users of Haas machines are the true beneficiaries of this unique relationship," he stresses, "because they receive more value for their machine-tool dollar."

Motorized probe heads and probe tool change racks (left) speed part verification during post-process inspection.

To deliver that value, Haas applies Renishaw technologies at many levels of the manufacturing process:

- Precision laser calibration of machine tools in Haas' factory ensures the highest manufacturing and measurement accuracies.
- Fast ballbar checks of machine accuracy, done on a regular basis, verify process capabilities in the Haas shop and on new machines before shipment and at delivery.
- In-process probing increases factory throughput, allows tightest tolerances and helps automate machining operations for 24/7 production, while reducing staff and costs.

QC10 BALLBAR CHECKS: THE QUEST FOR THE PERFECT PROCESS

In 1994, Renishaw introduced Haas to its QC10 ballbar, a timesaving calibration tool that diagnoses dynamic machine errors. The QC10 ballbar allowed Haas designers to learn more about each machine's geometric capabilities and repeatability. Careful analysis of ballbar data led to product design refinement and manufacturing adjustments.

Affixed magnetically between a machining center's spindle and table – or the chuck and tool turret of a lathe – the QC10 ballbar tracks machine movement to ±0.5 micron with a precision transducer. This allows an assessment of the machine's contouring performance through the measurement of circularity error, servo gain mismatch, vibration, stick-slip errors, backlash, repeatability and scale mismatch, as well as machine geometry errors.

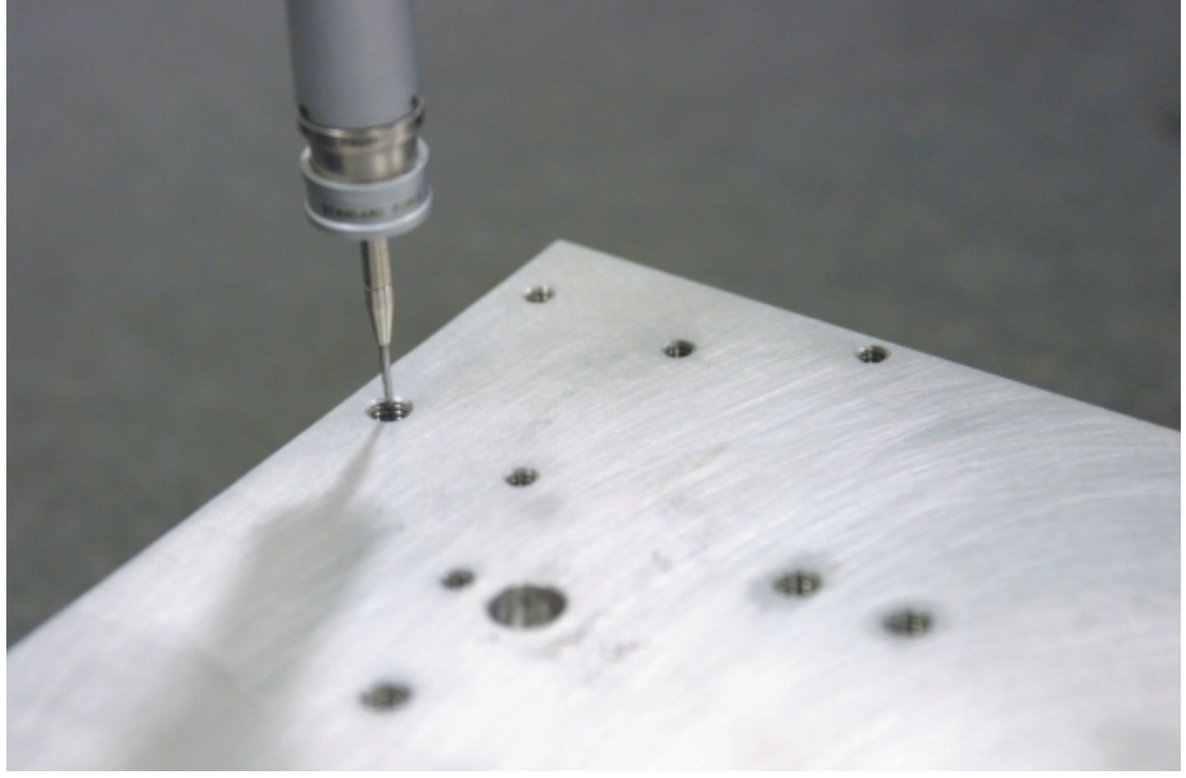
Haas performs QC10 ballbar tests on all new machine tools prior to shipping. In addition, all personnel in Haas' worldwide Haas Factory Outlet distribution network are factory-trained with the Renishaw ballbar system and use it to re-verify machine performance during installation at the customer's facility.

Haas also uses the QC10 ballbar on its own factory production machines to verify process capability. Early error detection with the ballbar ensures efficiency in scheduling maintenance and repairs. QC10 ballbar inspection can also be used to grade machines according to their accuracy and assess contouring performance per ASME B5.54 and ISO standards.

LASER FOR LINEAR AND ROTARY CALIBRATION

While the QC10 ballbar is an excellent diagnostic tool, a laser interferometer is used to compensate for the errors it uncovers. Haas uses Renishaw's ML10 laser interferometer to adjust linear compensation tables, as well as assess axis straightness, squareness, parallelism and angular (pitch/yaw) errors.

The ML10 uses an "eyes safe" Class II, low-power, frequency-stabilized helium-neon laser that provides a resolution of 1 nanometer



(0.000000039"). It works by emitting and splitting one laser beam of a given wavelength, with half of the beam reflected back to the laser at a fixed distance and the other half reflected from the changing machine position. Interference occurs when the two beams are returned to the laser, and distance is precisely measured.

Haas can carry out all development, build, quality and final test runs with this single laser system. Vibration analysis, drive control velocity functions and automatic scale or lead screw compensation can also be performed with special control-specific software packages.

Combining the ML10 with Renishaw's EC10 environmental compensation unit has allowed Haas to evaluate the effects of thermal dynamics during prototype testing. The EC10 monitors air temperature, barometric pressure, humidity and machine material temperature in real-time, then compensates the measurement data. With this information, Haas engineers can evaluate machine performance as the machine goes through the natural phenomenon of thermal expansion.

Haas also uses another laser option, Renishaw's RX10 rotary table calibrator, for improved table design and reliability. The RX10 calibrates rotary tables quickly to less than 1 arc-second.

ON-MACHINE PROBING FOR PRODUCTIVITY

Under pressures similar to those experienced by its customers, Haas was faced with growing demands for higher accuracy and shorter delivery times. Its machine shop was charged with reducing setup time and maximizing machine efficiency to meet growing demand for new machine tools. Besides aggressively addressing cutting parameters and fixturing simplification, setup/changeover and part validation times were areas targeted for improvement. Renishaw's MP10 probing system provided a big piece of the process-optimization puzzle.

One of the first groups of machines targeted for improvement was a collection of large-travel five-sided machine tools used to cut large castings. Fischer Mou, Haas Machine Shop Manager, recalls the process control limitations before Renishaw probe systems were installed. "For large castings, it took at least two hours for an operator to fixture the part on the machine, level the part to machine axis and take a trial cut to verify the casting had sufficient stock," says Mou. "And machining could start only if an operator was present."

With the introduction to the Renishaw probing system and "interactive macro" programming, Haas was able to let the probe compensate machine axes, verify sufficiency of stock and determine the number of required roughing passes. "Setup was reduced to simply fixturing the part and pressing Cycle Start," says Mou. "The probe system with macro programming is like having a highly skilled operator standing by the machine at all times, constantly checking part and machine. Perhaps the biggest benefit for us, though, is that the probes allow lights-out manufacturing of quality parts."

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"The thing that sets Haas apart is the gains it has achieved from a unified metrology and calibration strategy that controls product quality from the raw casting to the time a new Haas machine starts up in a customer's plant."

The large horizontal machining centers in Haas' flexible manufacturing systems (FMS), which perform a significant portion of daily production, were also targeted for quality upgrade. These machines were originally equipped with low-end conductive probing systems that had limited capabilities. Haas' quality and precision needs quickly surpassed these probes' capabilities.

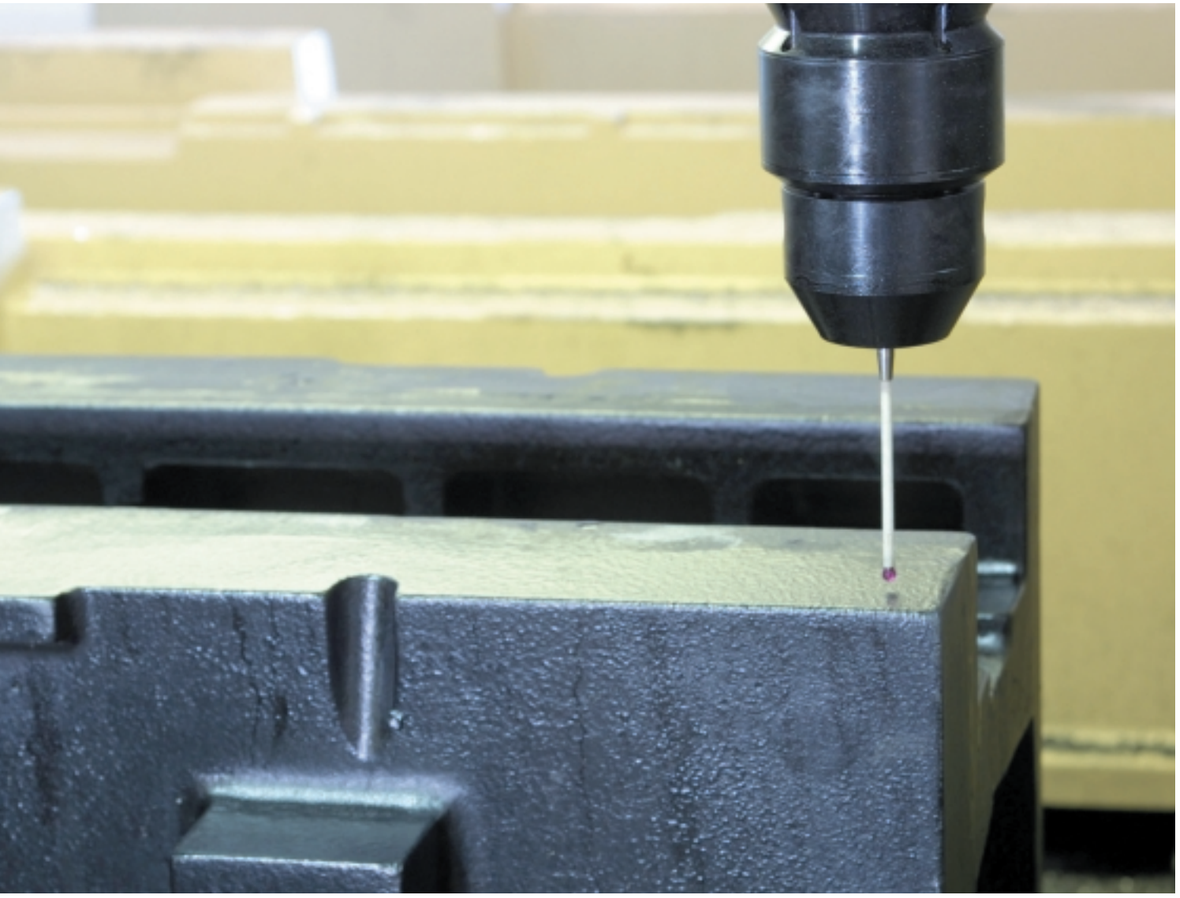
After reviewing the processes and machine capabilities, Renishaw recommended retrofitting all 20 machining centers with MP10 optical transmission spindle probe systems to provide higher levels of accuracy, reliability and confidence.

One part that demonstrates how probing came through for Haas on these machines was a motor mount in which the linear position of a bore to the flat mounting surface was specified at ±0.0005". Before the MP10 system, the machine positioning tolerance combined with probe tolerance made it impossible to accurately establish any surfaces. Now, the MP10 probes the finished mounting surface, stores the location down to machine resolution and verifies the pre-finished bore dimension. After tool change, the mount's bore is machined to better than 0.0002" true position tolerance.

As a pre-machining safety check of fixtures having multiple stations, the probe system is called on to verify that each station's part is properly loaded. If a part is found to be misloaded or a fixture station is empty, the control can

photo courtesy Renishaw

Post-process inspection verifies the accuracy of first-article parts and validates the manufacturing processes.



flag the operator, skip the station or stop the process.

The MP10 system also allows Haas to check for inconsistent casting dimensions that might result in wall thicknesses that are too thin or features with too much stock. The probe allows internal macro decisions to be made before a single chip is cut, saving valuable processing time and material.

CMM PROBING, VERIFICATION

Haas uses a variety of CMMs when post-process inspection is required, including two LK G-90Cs, one Sheffield RS-150 and one manual Mitutoyo B706. All are equipped, as appropriate, with Renishaw probe heads, probes and probe tool change racks, including PH10M motorized heads and TP2, TP20, TP7 and TP200 probes. The TP7 and TP200 are among the most reliable and repeatable CMM probes available in the world.

EFFECTIVE CELL, AEROSPACE PART PROBING STRATEGIES

In 1999, Haas designed and began production of its own CAT-40 toolholders, with a manufacturing cell designed specifically for toolholder production. The cell is equipped with 12 Haas CNC lathes, one Haas horizontal machining center and a Haas-designed and -built material handling system. The cell is designed for 24/7 production with virtually no operator intervention. In fact, the 13-machine cell is staffed with only three operators.

Before implementing a cell probing strategy, Haas evaluated a variety of competitive technologies and selected Renishaw's off-the-shelf probe systems, based on ease of use and flexibility.

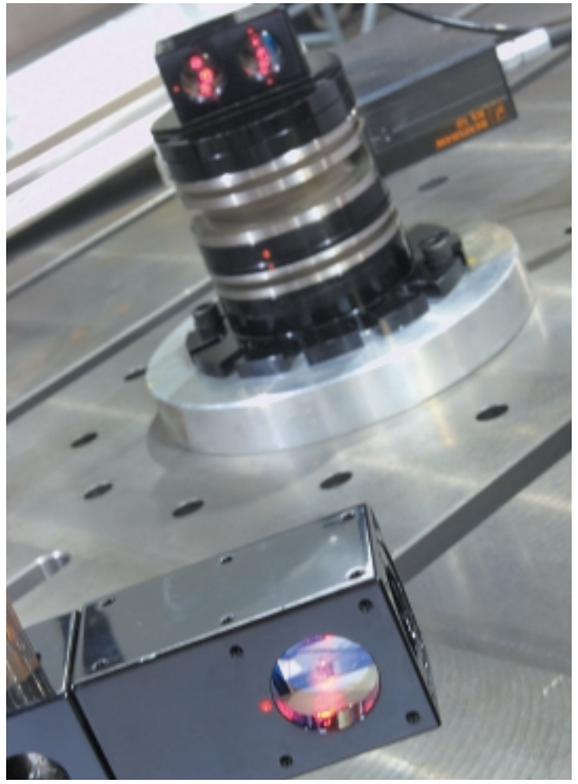
Similar to process automation on horizontals, lathe probing routines enable in-process inspection, automated adjustments and operator flags. The lathe probes also compensate for machine thermal changes during the process, as well as help prolong tool life. The cell has exceeded production and quality expectations. (Haas has since discontinued toolholder production, and uses this cell for high-volume production of common machine components.)

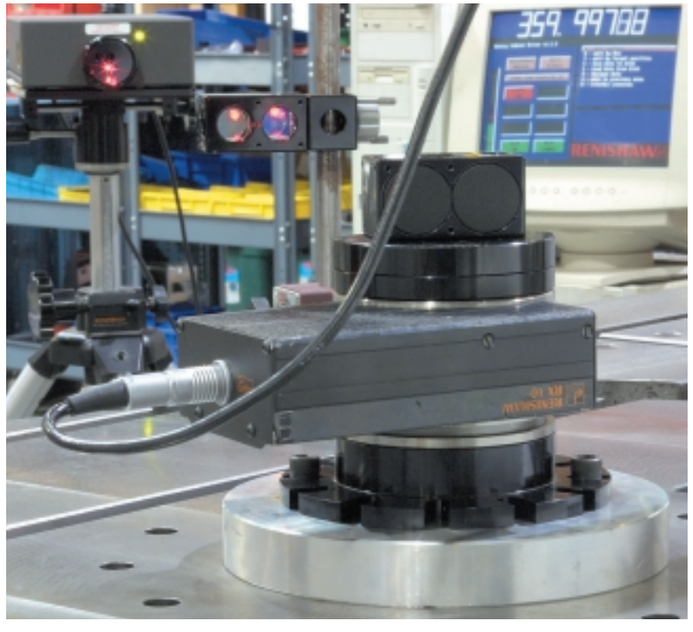
Haas' newest business venture is to develop machine tools and turnkey processing for five-axis aerospace applications. The company is exploiting Renishaw's extensive knowledge of machine tool calibration requirements for the aerospace industry to establish its own performance-testing criteria.

"We are deeply involved with all of the global aerospace companies, and we can provide technical support for machine tool calibration, on-machine probing and quality control both during the manufacturing process and at final inspection," says Renishaw's Rogers.

Rogers emphasizes that the metrology strategies used by Haas are available to any shop. "The thing that sets Haas apart is the gains it has achieved from a unified metrology and calibration strategy that controls product quality from the raw casting to the time a new Haas machine starts up in a customer's plant. Similarly, job shops can set themselves apart from their competition by implementing Haas' single-platform calibration and probing template. They just need to follow Haas' lead to boost their own throughput and accuracy through advanced metrology technology."

Renishaw
847-286-9953





On-machine probing of castings prior to machining (facing page) reduces setup time and allows lights-out manufacturing of quality parts.

Renishaw's laser rotary calibrator (above and right) is used to verify the accuracy of the built-in 4th axis of the Haas HS-3R horizontal machining center before shipping.

Unfathomable Numbers, a White Knight and a Virgin

story & shop photos
by Olaf Wolff

photo by Joe Maggiore

A provocative title, yes, but it's not merely intended to entice you into reading on. There's a strong commonality connecting these three references that is, in fact, more interesting than the superficial imagery they invoke.

This is a story about creating silicon microchips, parts per trillion and PTFE (polytetrafluoroethylene, the generic term for Teflon®). Okay, so the heading's summoning visuals may ring more interesting, but let's move on.

It's a Family Affair

In 1988, John Simmons borrowed $7000 from a family friend. John had a vision and this was the first step toward its manifestation. The loaned money went to purchase a used Bridgeport mill, which was then stationed in his parents' garage in a suburb of Salt Lake City, Utah. John, his brothers Tom and David, and occasionally their father, Jack, subcontracted various parts for local businesses – mainly plastic and fluoropolymer components for the semiconductor industry, and for the medical and robotics industries.

Within a couple of years they moved the operation out of the garage and into a small shop, forming A&J Machine. The machine shop continued to grow. "We bought our first CNC machining center, a used Haas VF-2 (serial #1775), from Al Stefani of Stefco Racing. Al was an old motorcycle riding buddy of Gene Haas. We still have the same machine working in this present shop," reminisced John.

It's interesting to note that this specific machine was the first CNC for both Stefco and A&J Machine. "Perhaps there's another fledgling shop looking to purchase its first machining center. There's plenty of life left in this one," John adds coyly. "We might consider selling it."

In the early 1990s, John and brother Tom started developing their own products. They had a customer in the Salt Lake City area who was building high-purity pumps for siphoning acids during the production of microchips in the semiconductor industry. Word of mouth had it that the company was getting a load of customer complaints regarding the pumps' reliability and the lack of service. John and Tom were inspired – and confident they could build a better pump. They spent the next three years in R&D, absorbing all they could about the requirements of the semiconductor acid pumping business. They developed and unveiled their first pump at Semicon West 1995 in San Francisco, an annual industry trade show. The brothers had done their homework fastidiously, and the pumps were a standout hit. White Knight Fluid Handling, Inc. was conceived.

At that time, real estate costs in Salt Lake City had skyrocketed. "We recognized this would constitute an additional complication to building a company there," says John. "I had spent some time in Michigan, showing our patents (the pumps are presently protected by seven patents, with two more pending) to companies and discussing licensing them on our technology. I fell in love with the state and the idea that I could live in a rural setting, yet be close enough to the 'big city' for our manufacturing needs. With property values at nearly half what they were in Salt Lake, the decision to move wasn't that difficult," he adds.

The entire Simmons family now lives and works in Michigan, including the youngest brother, David, who is fluent in Japanese and handles all Asian distribution. Their one sister, Careen, will also join the company upon her return from a two-year church mission in Italy.

The Simmons family bought and totally refurbished the present home of White Knight in Hemlock, Michigan, an impressively designed and organized building, filled with the most contemporary gadgets (i.e., computers and other business electronics). Their reasoning for keeping electronically and mechanically up to date is simple: when customers visit, seeing cutting-edge technology makes them comfortable doing business. When your customer list includes Intel, Motorola, Texas Instruments, IBM, AMD, National Semiconductor, Fairchild Semiconductor and Philips Semiconductor – to name but a few – this is indisputable, pragmatic logic.

Worldwide Distribution

White Knight's pumps are used worldwide, almost exclusively for the semiconductor industry. The company's claim to fame and secret to success is that their pumps test considerably better than any other pump on the planet with regard to metal contamination when acids are drawn through them.

Most of us are aware that you can short out the wiring in your house by placing a metal object between two wires. Now imagine this on a microscopic scale. Today, the standard line width of circuitry on a

John and Tom were confident they could build a better pump. They spent the next three years in R&D, absorbing all they could about the requirements of the semiconductor acid pumping business.

microchip is 0.15 micron (a micron being one millionth of a meter or about 0.000039 inch). What that means is that approximately 526 microscopic circuit lines could fit side by side on a human hair. In this environment, where layers of material are only several atoms thick, any microscopic metal that ends up in the chemistry during wet etching or cleaning (the steps that involve pumps and acid) could potentially short out the microchip.

Obviously, metal contamination is not good in the microchip industry. The standard of measurement for contamination when testing pumps is in parts per trillion (unfathomable number example: a trillion seconds is nearly 32,000 years). It's not uncommon for White Knight pumps to test in the single digits in parts per trillion – and never more than in the low double digits.

The Knight Way or the Wrong Way

Presently, there are only two methods of achieving this extreme level of pump fluid purity. First, make a pump totally devoid of any metal and other contaminants, and second, assemble it in a clean room (Class 100). White Knight has accomplished both, the former being the difficult part. They have been able to create the world's first pump containing nothing but Teflon – no metal whatsoever. Others claim to have succeeded at the same thing, but they've all been exposed.

Competitors make pumps from Teflon, but fasten them together with nuts, bolts and screws. Revealing these shortcomings was simple – the pumps confessed on their own. The molecular structures of the acids (phosphoric, sulfuric, hydrofluoric and others) used during the wet etching process are so minute that they permeate plastics, passing through in a vaporous form. To complicate things further, the industry then uses these acids at temperatures up to 410 degrees Fahrenheit (basically the temperature of French-fry oil), and if there's metal anywhere in the pump the acid will attack it, dragging pieces back into the liquid, where it ends up as a short in a microchip.

Too Soft for Comfort

The formidable challenge with creating a pump totally of Teflon is the softness of the material. It's just slightly harder than bar soap, making it tough to hold tolerances (which are checked daily). "We hold our tolerances to plus or minus 0.002 inch. That doesn't sound like much, but it's not the equipment's fault. Teflon just doesn't hold its shape well, especially when you remove more than 50 percent of the material for fluid cavities and liquid flows," commented Tom.

Due to Teflon's very high coefficient of thermal expansion, high-speed machining isn't an option, because the heat generated would cause even more interference with holding tolerances. Therefore, coolants aren't required, which is favorable, because they would only contaminate this very porous material.

"Most industry experts adhered to the belief that Teflon was too soft to be threaded together, and they were afraid that it would lead to acid leaks and, no

The formidable challenge with creating a pump totally of Teflon is the softness of the material. It's just slightly harder than bar soap, making it tough to hold tolerances.

doubt, serious injury," John told us. He adds, "We figured out that with a CNC machine it would be feasible to synchronize the starting points of the inside and outside of a thread hob and make a combination cap/plug, screw it together and have twice as many threads as anybody else's pump." Both John and Tom share the credit for this breakthrough.

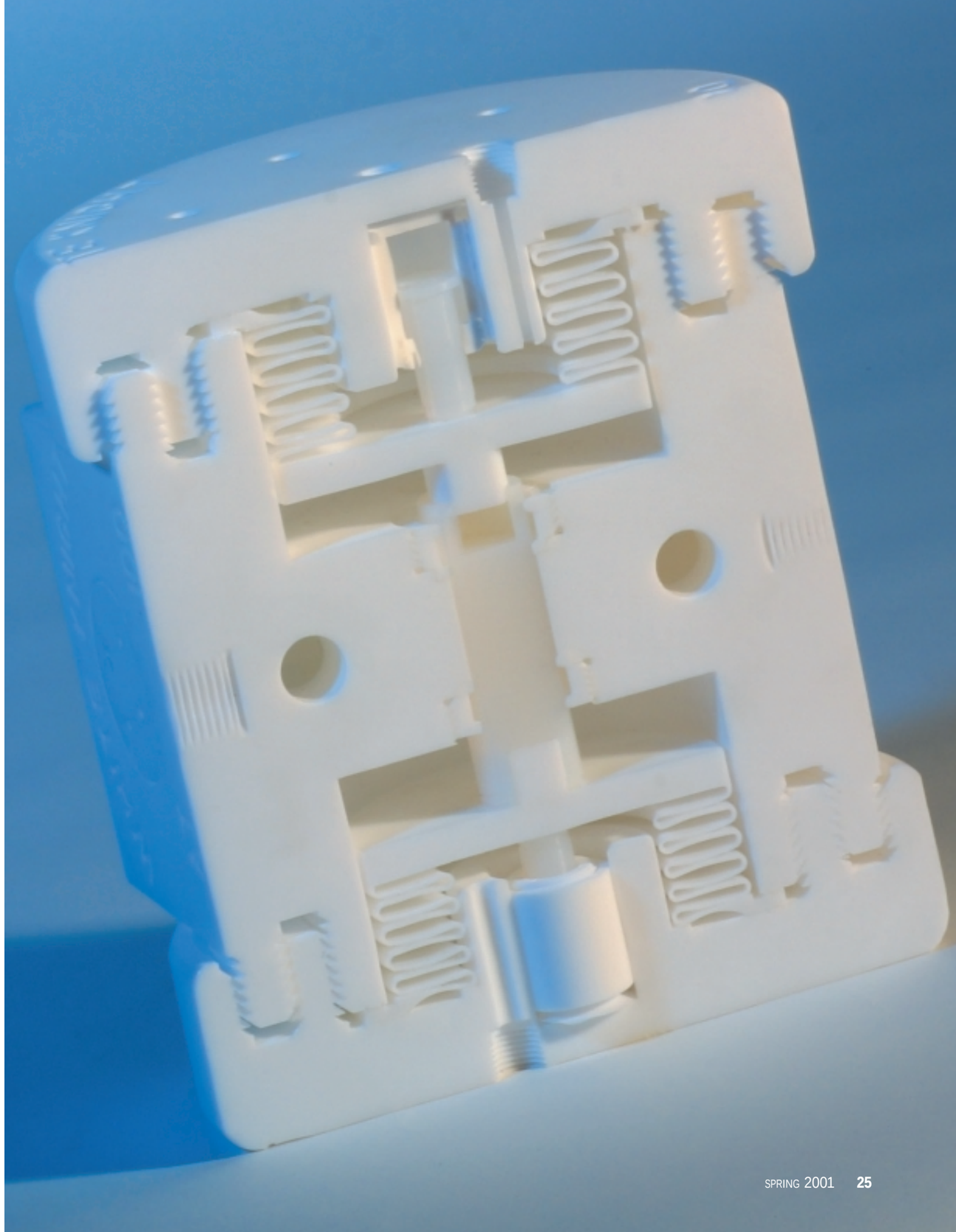
Several special tools are required to create these threads (for obvious reasons, the Simmonses are reluctant to reveal too many specifics regarding their special tool designs). The first tool is used to trepan a groove 0.07" wide and 0.75" deep. This is cut with a peck drill cycle on a Haas mill. The next tool is a custom-designed tap/die that has both internal and external threads. This threads both sides of the aforementioned groove using a rigid tap cycle. The real difficulty the Simmonses had to overcome was that by the nature of the tap/die there isn't much room for chip clearance. The tool must be programmed to tap part way down, retract to clear the chips, re-tap further, retract again, and so on for at least four passes to reach the bottom. "This capability was very important when we were looking for our first machining center," explains Tom. "Haas was the only tool manufacturer to guarantee that we could repeat a rigid tap without fear of cross threading."

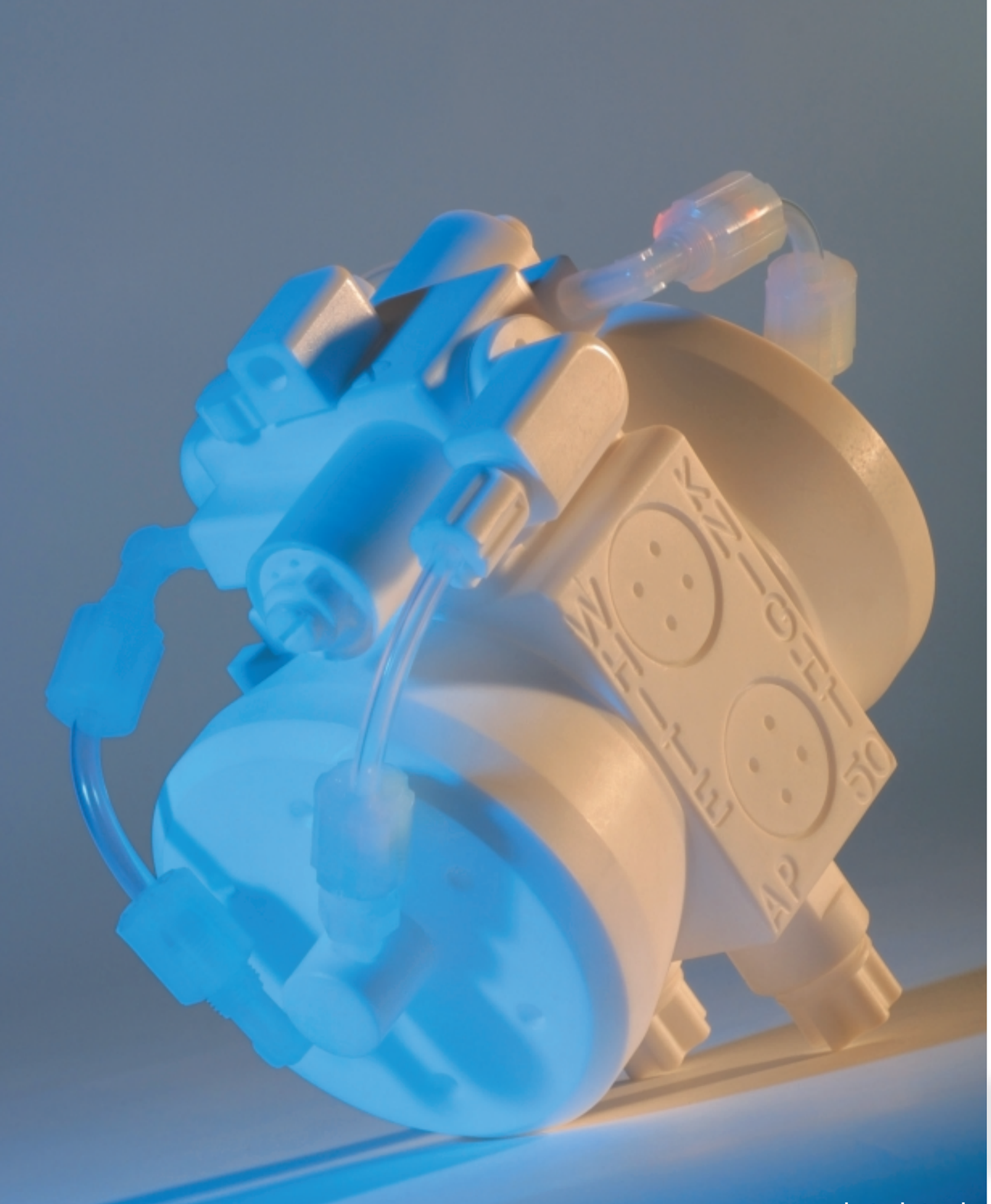
Most of the other tools used are standard, such as endmills, drills, et cetera – the same as for cutting aluminum, except the tools last nearly forever. The majority of tools scrapped are due to nicks resulting from being bumped while putting them back in the tool cart, not from wear. The Simmonses also use a number of Haas rotary tables in order to machine four sides of a pump in one setup, which is a huge time and money saver. Presently, White Knight owns six Haas machining centers to satisfy all their machining requirements – a VF-1, VF-2, three VF-OEs and a VF-3.

Virgin Teflon

"The semiconductor industry forces us to use only virgin Teflon: Teflon that hasn't been used before, not recycled," clarifies John. Pure virgin Teflon or PTFE, which hasn't been cured or baked, comes in the form of a light fluffy powder. It's only after a very labor-intensive procedure that virgin Teflon is structured into the 7 x 7 x 7 inch blanks used by White Knight to mill the principal pump components. It's a specific and costly procedure. Each raw blank of virgin Teflon costs around $150, and even a miniscule hint of contamination, such as hair, lint, dust particles, et cetera, will turn into large black specks in the blank. Many times these are not visible until a final operation – making for useless parts and wasted time.

Due to the cost and the many variables involved in producing perfect blanks, White Knight has recently undertaken the task of producing their own blanks. The powdered PTFE is weighed and poured into the mold (a stainless steel container with a removable bottom).





The mold is then placed into a hydraulic press and the powder is compressed at approximately 3,500 psi, based on the size of the billet being pressed. The compressed billet is then removed from the mold (at this point the billet is solid, but will crumble like a dirt clod) and cured in an oven at around 700 degrees Fahrenheit. The curing/baking process will bring the Teflon molecules to the point where they will gel together. Teflon must be molded in this slow and deliberate way, as it does not melt or share other common properties with most plastics. If heated too far beyond 700 degrees, Teflon will begin to turn into a gas, much like dry ice does as it melts. Depending on the size of the billet, a short curing cycle is around one day; longer cycles may take five to six days. There's little doubt that the Simmons family will perfect, or at least improve on, this procedure as well.

As a result of their combined hard work, determination, unified creative thinking and steadfast faith, the Simmons family is making the most of opportunities and living their vision. We passed the rural street where White Knight is headquartered three times before getting it right. High-tech in country camouflage is always so deceiving. But there it was, White Knight and their daily dealings with incomprehensible numbers and thousands of pounds of virgin Teflon.

White Knight Pumps & Fittings, Inc.
517-642-3237

product photos by Scott Rathburn

The industry forces us to use only virgin Teflon: Teflon that hasn't been used before.

PC-BASED SOLID MODELING: A Plus For Every CAM Shop

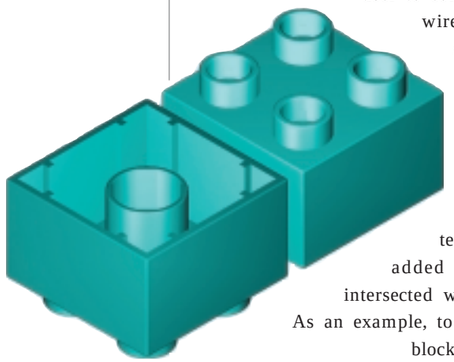
Solid modeling is no longer a tool available only to large manufacturers with workstation capability and the constant need to design in 3D.

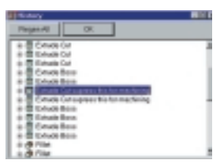
Story
Gary Hargreaves

PC-based solid modeling has given the CNC machining industry a tool which has helped level the playing field for many shops. As a stand-alone or an integrated part of a versatile CAM package, solid modeling capability increases the adaptability of almost any machine shop. That can mean new customers, increased business and reduced costs.

THE BASICS OF SOLIDS

Solid modeling lets the user build a model from well-defined solid bodies instead of requiring the user to construct each feature as a wireframe or collection of surfaces – one wireframe entity or surface of the model at a time. The user can start with a simple shape. This body is then modified using other bodies and techniques which might be added to, subtracted from or intersected with the evolving model. As an example, to place a hole through a block in a solid model, the user simply removes the quickly-defined cylinder from the block volume. To create the same shape using surfaces would require a skilled user and seven separate surfaces.





The result in solids is still a single, solid body; by definition, it cannot have gaps, cracks or overlaps. NC programmers know how gaps and unexpected imperfections in a model can require editing or re-creation, and they are often not found until toolpaths are created. They can also cause gouging or poor surface finish. Solid models tend to eliminate those problems.

Consider changing the depth of the part mentioned above. The surface model would require editing several different entities. With a solid model, the user only changes a single parameter. As the depth of the part is changed, the radii automatically conform to the new parameters.

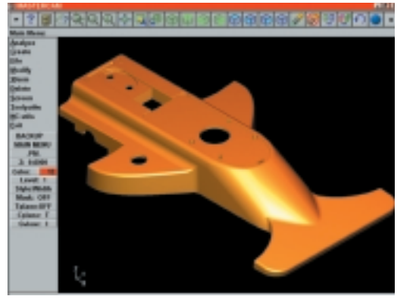
WHO CAN USE SOLIDS?

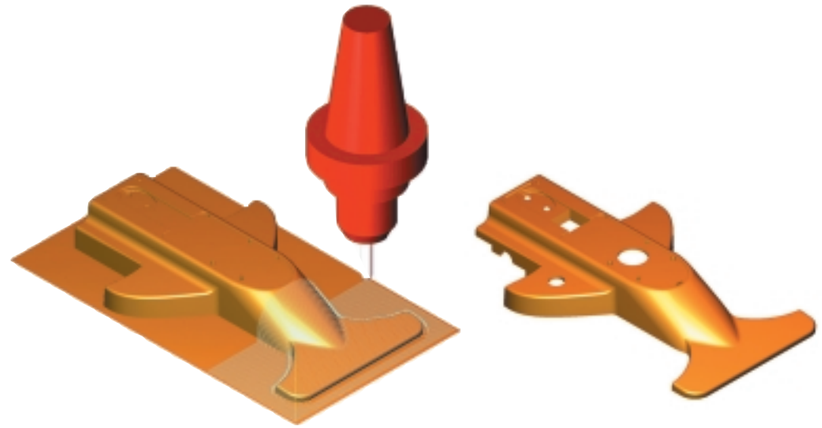
Even a shop that primarily does 2D work from others' designs can benefit from the economical solids packages available today. A solid model provides high-quality edge curves and other data needed for 2D or 2.5D operations such as pocketing, contouring and drilling. And the solid file lets you see the entire part, not just 2D prints or wireframe.

For a shop that designs in 3D, solid modeling can allow users to work significantly faster than wireframe/surface modeling. The speed and accuracy of solid modeling contribute to reduced time to market, now more crucial than ever. Modeling in solids is also perfect for conceptual designing – in this process, sizes and shapes change continually, and solids easily accommodate such changes.

It is important to note that machining solids does not require any special NC programming functions. Users apply toolpaths to a solid in much the same way they would apply toolpaths to other models. Most shops are already proficient in machining wireframe and surface models. Adding solids to the mix gives a shop the capability to use the type of data they want: wireframe taken from the solid, surfaces taken from the solid or the solid itself.

Solid modeling lets the user build a model from well-defined solid bodies instead of requiring the user to construct each feature as a wireframe or collection of surfaces.





OTHER UNIQUE FEATURES OF SOLID MODELING

In addition to its relative ease as a modeling method, solid modeling brings with it capabilities not available in wireframe or surface modeling.

Piece by piece – Pattern makers have historically added and subtracted actual sections of solid material to satisfy the designer's specifications; machinists generally think in terms of removing material from a block. Solid modeling performs its operations in the "mindset" that is second nature to pattern makers and machinists, one piece of virtual material at a time.

Volume and mass – Solid modeling provides detailed volumetric data. This allows accurate mass calculations – volume, center of gravity and moments of inertia.

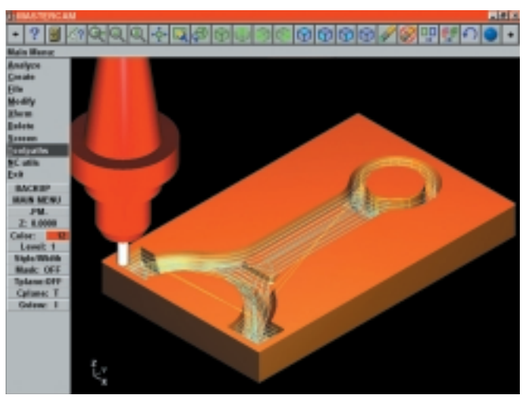
Shelling – Solid modeling also offers the easiest way to construct parts with a wall thickness, common to such industries as plastic molding for consumer products. Once the solid shape is created, the designer enters the thickness he or she wants to remain after the process, and the solid modeler removes the excess material.

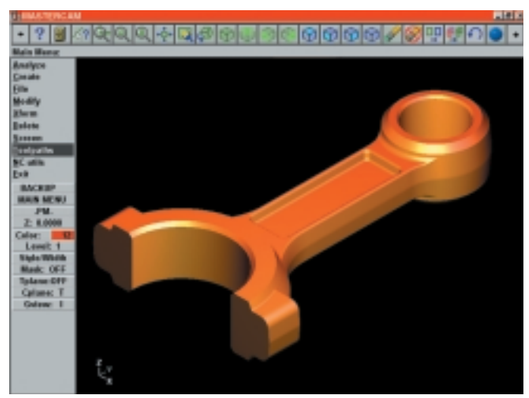
Feature Control – Most solid modeling systems create a "history tree," a step-by-step record of the sequence of the solid's creation. The history tree provides direct, integrated access to track back to the critical point for such changes. A history tree can also suppress certain features, removing them from the model temporarily. This is a plus for programming, because it allows you to machine only the areas you need in a particular operation.

Learning curve – A CAM seat with solid modeling capabilities allows beginners to create high-end 3D models without the extensive experience that is often needed for good surface modeling. That means new users are cutting chips much sooner. And if programmers already know CAM, and their package has a well-integrated solid modeler, they can be creating and machining solids very quickly.

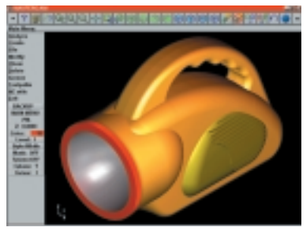
SURFACES STILL SHINE

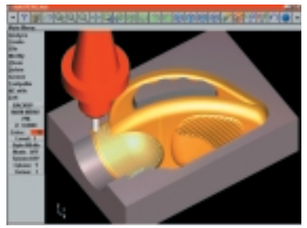
Many industries, including automotive (auto body panels), aerospace (fuselage design) and jewelry (complex, flowing scrollwork on rings) still extensively use surfaces to define more complex geometry. Many other customers work with surfacing CAD systems and send those files to job shops. In many cases, surface modeling is still better at generating the organic or ergonomic forms common in

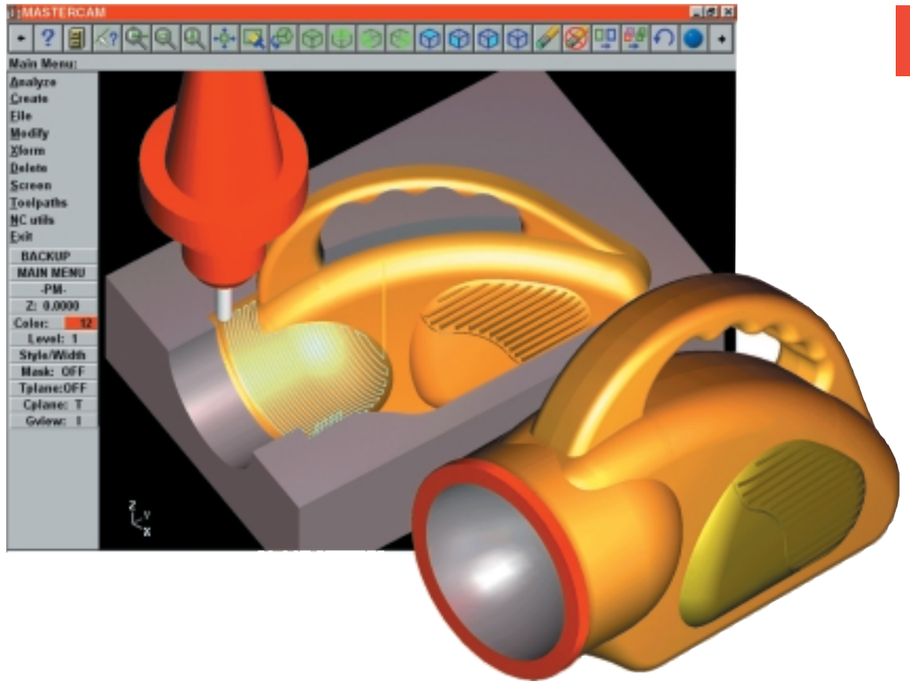




From the technical viewpoint, solids-equipped shops can import designers' files with greater reliability by bringing in native solids files.







toolmaking – especially the forms derived from sections and drive curves, and in blending one irregular surface form to another. Far from being replaced by solids, surface modeling capability is very much needed to import, repair, work with and machine those files, and is often a necessary complement to solid modeling.

HYBRID MODELING – THE RIGHT TOOL FOR THE RIGHT JOB

While solid modeling is just the ticket for many designs, there are some which demand the combined use of solid and surface modeling, particularly in the tooling business. In a hybrid system, a solid model may be used to generate a basic shape to which complex sculpted or ergonomic shapes are added with surface modeling, in a single environment. One example is a hearing aid design in which an organic ear fitting is connected to mechanical parts. The majority of the hearing aid components can be modeled easily with solids; the organic ear fitting is more easily modeled using surfaces.

WHY CAM NEEDS SOLID MODELING . . . NOW!

Competitors capable of bringing in solids files will gain business as more and more customers supply solids files. If your potential customers use solids, they will expect you to work with them as well.

From the technical viewpoint, solids-equipped shops can import designers' files with greater reliability by bringing in native solids files. And, since the files come in with no holes or overlaps, your shop doesn't spend the time to correct them: a distinct financial benefit.

If your shop is solids-capable, most customers' changes and additions can be executed much faster and easier if you're using a native solid model.

Because of tight turnaround times, efficient, streamlined CAD is the best choice for a programmer, and solid modeling is no different.

SELECTING AND SUPPORTING THE SOLIDS PACKAGE THAT'S RIGHT FOR YOU

CAD models that can be machined as-is with no modification or supporting geometry are rare, and more and more shops are doing part modeling for their clients. Thus, programmers have as much need for fast, efficient, high-quality CAD functions as design engineers. In fact, they may have more to gain, as a machine shop's deadlines are often much tighter than those in product design alone. Because of these tight turnaround times, efficient, streamlined CAD is the best choice for a programmer, and solid modeling is no different. So, above all, your selection should include solids functions that are easy to learn and use.

If you have an existing CAM program and you want to add solids to the mix, you have a few options:

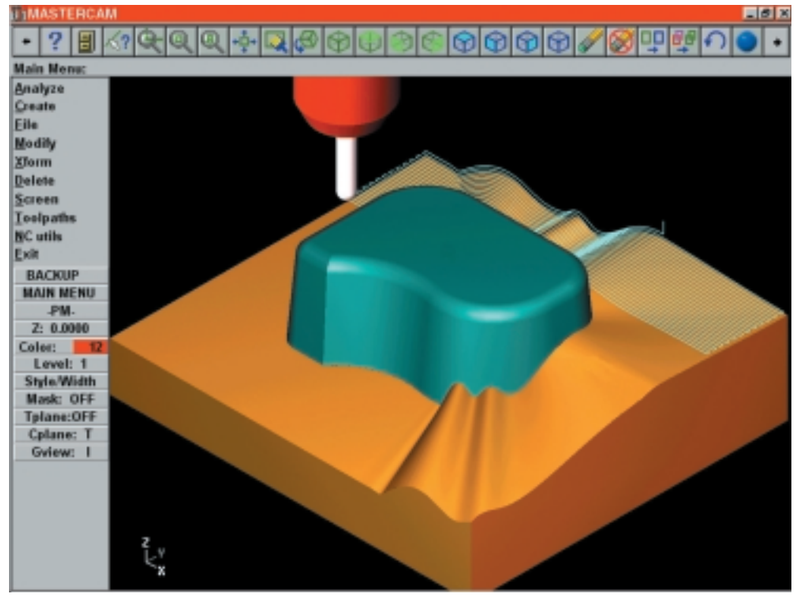
Purchase a stand-alone solids system, then translate those models to your CAM software as surfaces via IGES or another file format. This gives you portability – you can have your solids design in one room and your CAM programming in another.

Upgrade your current CAM system to include solids, if the developer offers that option. If you intend to machine solids, you'll need some level of integration. At the very least, you'll need to be capable of bringing in a solid as a solid and applying toolpaths to it. To edit or create solids and machine them directly, you'll need an integrated solids/CAM package that offers modeling and NC programming functions in the same environment.

Add an integrated solids/CAM system to your software tools. In many cases, investing in a new, full-featured CAM product with integrated solids can generate savings in production cost over time. Having solid and surface modeling seamlessly integrated within a powerful CAM system gives you complete access to all the modeling capabilities you would need. If there's a change in a part, you don't have to translate it back and forth between separate packages. You can make the change and keep right on going. If you own a stand-alone solids system, a compatible integrated solids/CAM system will allow you to preserve the solid as a solid, make changes easily and machine the solid directly.

Solid modeling has revolutionized the design industry, and is becoming more widespread in the machining industry every day. Solid modeling can speed part and tooling design, and can even help produce cleaner, more accurate finished parts. NC programmers are finding a valuable tool in solid modeling . . . one of the fastest-moving trends in our industry.

CNC Software, Inc.
800-228-2877



CNC Technology Classes Deliver Big for El Camino College Students

Story & Photos
Olaf Wolff

The CNC machine tool industry is one of the most monstrous businesses on this planet, yet, essentially, only those directly involved know anything about it. It's an industry that moves along enthusiastically fast; the technology changes quickly and often in great leaps. CNC machine tools are also very cool.

You'll surely agree if you ever have the opportunity to witness a five-axis trunnion machine doing its thing. It boggles the mind that so many things can happen from so many angles to a chunk of metal, transforming it at near light speed into something useful. For veterans of the business this is old news, but tell an outsider you work for the biggest machine tool manufacturer in America – Haas Automation – and watch that "Oh that's nice" look slide down their face. But, make the point that if it rolls, flies, floats, fixes things, dries hair, shoots to the moon, or basically touches their daily lives, machine tools were involved at some point – you'll usually get an enlightened "Oh really."

At Haas, the machine operators / programmers – the good ones who have paid their dues – are at times humorously referred to as the rock stars of our industry. They play CNC machines with the virtuosity and abandonment of an Eddie Van Halen. Machine tool operators all over the globe contribute great and necessary things to our lives, yet very few people outside of the business know about it. There clearly appears to be a PR problem.

What makes it even more disconcerting is that nearly anyone, man or woman, with basic mechanical aptitude, math and reading skills, and a desire to work with their minds as well as their hands, can qualify. Programs such as the ones at El Camino College in Torrance, California, offer a variety of machine tool technology classes on Haas CNC machines. El Camino possesses one of the many Haas Technical Centers that are part of an expanding nationwide network. Classes range from very basic to complete certification programs, which upon successful completion can get students working – based solely on their school experience. After several years of journeyman experience, the hourly pay range rises significantly, the distinction being that instead of relying on mere credentials, the machinist's earning power is directly proportional to his or her ability.

Haas machine tools and control simulators allow students at El Camino College to gain the hands-on experience they will need when they enter the workforce.

Ron Way is Dean of the Industry and Technology Division at El Camino College, a position he earned in 1992. His credentials are impressive. For seven years before teaching he worked as a tool and die maker, then went on to receive his MA degree in industrial education from California State University at Long Beach (CSULB). Dean Way was also a professor in MTT (Machine Tool Technology) and CNC machining / programming from 1975 until becoming dean at El Camino. Dean Way was incredibly gracious with his time, in answering my questions and, in particular, in helping me navigate through the 161-acre campus to the Technical Arts Department.

My first question for Dean Way (after How do I find your office?) was regarding the types of programming and level of proficiency offered at El Camino. "We provide various levels of sophistication in hands-on programming courses," he explained. "We offer CNC programming, of course, MDI (manual data input), verification with Predator software, G-code, NC Graphics, and two 72-hour courses featuring Surfcam 2000 and one 80-hour course featuring CATIA versions 4 and 5."

Professor Jerry Kinnan, the distinguished-looking white-haired and bearded gentleman who inaugurated the Machine Tool Technology program at El Camino back in 1970, relates a story filled with irony. He recently ran into a former student in the halls of TRW Inc. His immediate reaction was pride upon learning of the student's success as a machinist for the aerospace giant. On the other hand, Kinnan couldn't help being somewhat wistful that, in only a few years, the student's salary had surpassed his own. "But that's what's happening in the industry," said Kinnan.

A stickler for teaching the basics, Kinnan stresses fundamentals, making certain that, even though CNCs are clearly the future, students have a thorough understanding of concepts, from safety to measurements to blue prints and mathematics. Students

El Camino possesses one of the many Haas Technical Centers that are part of an expanding nationwide network.

completing his classes leave confident that they can successfully continue their machine tool education anywhere. Not until students have a basic understanding of CNC machines do they actually get to work on either the Haas HL-2 lathe or the slightly more mature VF-E vertical machining center.

During my visit, Professor Kinnan was instructing students on milling small brass and aluminum components for sideshaft atmospheric engines, also referred to as flame-licker, flame-eater, flame-gulper or hot-air engines. They function by drawing hot gases or a flame into a cylinder to be cooled, but technically they are "atmospheric" engines. A terrific basic CNC applications practice project, these engines are a rung on the ladder to someday milling full-blown turbine engines.

Professor Kinnan has definitely paid his dues. He spent approximately 10 years as a precision machinist prior to teaching, including a formal apprenticeship. During his teaching career, which spans more than 30 years, he's also taken two sabbaticals to update his skills, one at Northrop as a programmer and the other at CCS Packard to work with CAD / CAM integration and programming. Jerry Kinnan officially retired last June, but he still enjoys teaching part-time at the school, and students in the know are grateful for it.

To Professor Kinnan I posed the question of finding qualified instructors. "Yes, it has been very difficult to attract qualified, experienced instructors with a strong industrial and teaching background. But, I'm beginning to see an upturn in that trend," was his positive take on it.

Both Dean Way and Professor Kinnan agreed that interest in the program has increased since the introduction of the two Haas CNC machines. "We are able to offer a state-of-the-art curriculum, which has greatly improved our marketing and relevancy to what the industry is using," remarked Professor Kinnan. They also both concurred that their program focus is on the "general machinist," and that in today's marketplace, CNC programming, setup and operation are all part of being a journeyman machinist.

Possessing the skills to create useable materials from raw metal stock is, as I've mentioned, "sick" (that's "cool" for generation 2000). The Haas Technical Centers are nationwide, increasing as I write this. The potential to become a working, certified machinist is within reach. Now all that's left is that PR problem. Maybe a little advertisement on MTV would do the trick.

For information about teaching opportunities contact: Ron Way, Dean of the Industry and Technology Division, El Camino College 310-660-3600 or rway@elcamino.cc.ca.us

EUROPE continued from page 5

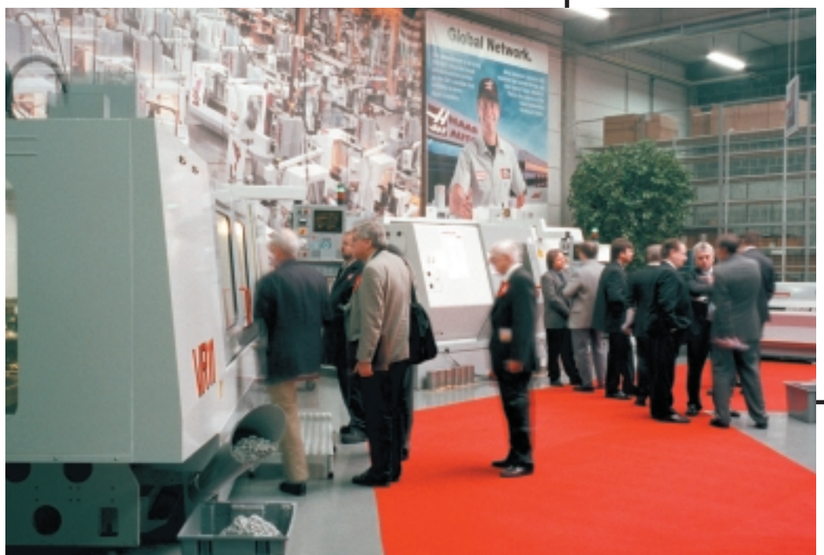
Automation Europe team. Engineers and machine shop owners came from all four corners of the European Union to see for themselves what more than 28,000 American machine shops already know.

I took advantage of a few quiet moments to talk to Gene Haas about the company's hopes for the new operation: "We have big plans for Haas Europe," he said. "I'd estimate that there's something like 100,000 machine tools sold every year around the world, and at the moment, we account for approximately 7% of that total. We'd like to increase our share to more than 10%, and we hope to win some of this additional business here in Europe. This will give us a very significant share in the global market, and the additional stability to cope with the ups and downs of individual markets. Also, when you have that kind of market share, it makes it very difficult for a potential competitor to enter the industry and steal your business."

I asked him about the idiosyncrasies of doing business in a multicultural environment like the EU: "Haas Automation Europe will appoint resellers in the key markets. It's these resellers that will obviously have the local knowledge and, we hope, will feed back vital information as to what kind of machines their particular markets want. We'll use this information to ensure that we build the right products to meet those requirements."

And how will you cope with the demand? I asked. "Currently, we're producing 500-600 machines a month at the Oxnard factory. If we need to, we can easily expand that output to more like 700 a month. If this isn't enough, we're capable of building additional plant very quickly.

"We're also anxious to establish links with educational establishments in Europe. This is something we've done very successfully in the United States, and we feel it will help to build our name and reputation very quickly."



Haas Automation Europe's Managing Director, Dr. Ing. Theo Leon, outside the Belgium showroom.

A view of some old-world Brussels architecture off the Grand Plaza.

Euro-Haas

If polyglotism is an attribute of a typical European, Haas Automation Europe's Managing Director, Dr. Ing. Theo Leon, is about as European as is, by most standards, conceivably possible. As I waited patiently in his office, he fended off a barrage of phone calls with courteous brevity and in a half-dozen different languages. The phone calls stopped for a moment and, in flawless English, he offered me a seat and added, "If we don't take this opportunity to talk now, we may not get another chance."

A mechanical engineer by profession, the young Theo Leon started his engineering life in the aerospace industry, moving into the rapidly developing machine tool industry in the late 1960s. His experience with many well-known machine tool builders eventually led to the founding of Leon International, a company specializing in executive search and selection, mergers and acquisitions and marketing consultancy for such organizations.

It was whilst running Leon International that Dr. Ing. Leon first came into contact with Haas Automation, Inc., providing consultancy services as the company researched key European markets and looked for potential distributors. "We've already appointed five German distributors," he told me. "Germany is obviously a key market for us, and the sales engineers from these companies will all be arriving here tomorrow to begin training on the different Haas machines. Once we have these guys trained and selling, we're doing the same for Austria, Spain, Portugal, Scandinavia and, a little later, Italy and France. We're going to be very busy."

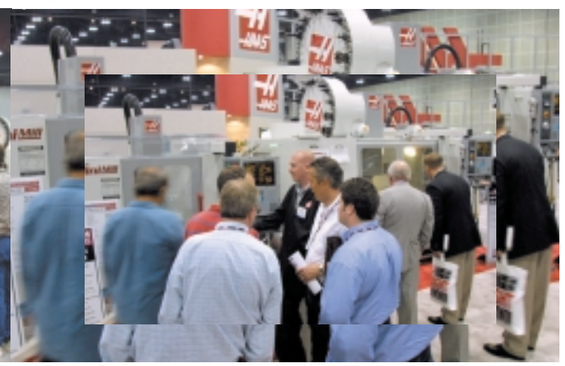
WESTEC 2001 – All Haas, All The Time

The largest annual metalworking exhibition in North America descended upon the Los Angeles Convention Center in March for its usual four-day stint. As expected, all of the key players in the machine tool world were on hand to show off their goods, including Haas Automation.

The 5,250-square-foot Haas booth at WESTEC 2001 was the usual beehive of activity, with 21 machines slicing through 40,000 pounds of steel and aluminum during the four days of the show, March 26-29. WESTEC's 37th year saw nearly 30,000 manufacturing professionals (most of whom passed through the Haas booth, it seemed) turn out to see the latest and greatest in machine tool technology from 800-plus exhibitors, both domestic and international. While overall attendance at the show was down from last year, many show attendees commented that the Haas booth was as busy as ever. There was certainly plenty to see, with CNC machines small and large throwing chips and turning out parts.

As always, Haas showcased several new products and prototypes, including two new "Mini Series" machines: the Super Mini Mill (with High-Speed Machining) and the Mini Lathe (pictured below), small-footprint machines with full CNC capabilities. The small machines were very big attention-getters – no surprise, given their mini prices combined with Haas quality and ease of use. The prototype Toolroom Mill, a non-enclosed machine combining the precision of the Haas CNC control with the convenience of manual handwheels, was also a highly popular item.

This year, SME (the Society of Manufacturing Engineers) decided to try something different at WESTEC by allowing exhibitors to sponsor show registration. Haas Automation was the only exhibitor to take up SME's offer, so the Haas name was literally all over the show, with show bags and lanyards being handed out at every registration site. Here are a few illustrations of just what it was that kept people coming to see what Haas Automation was up to.

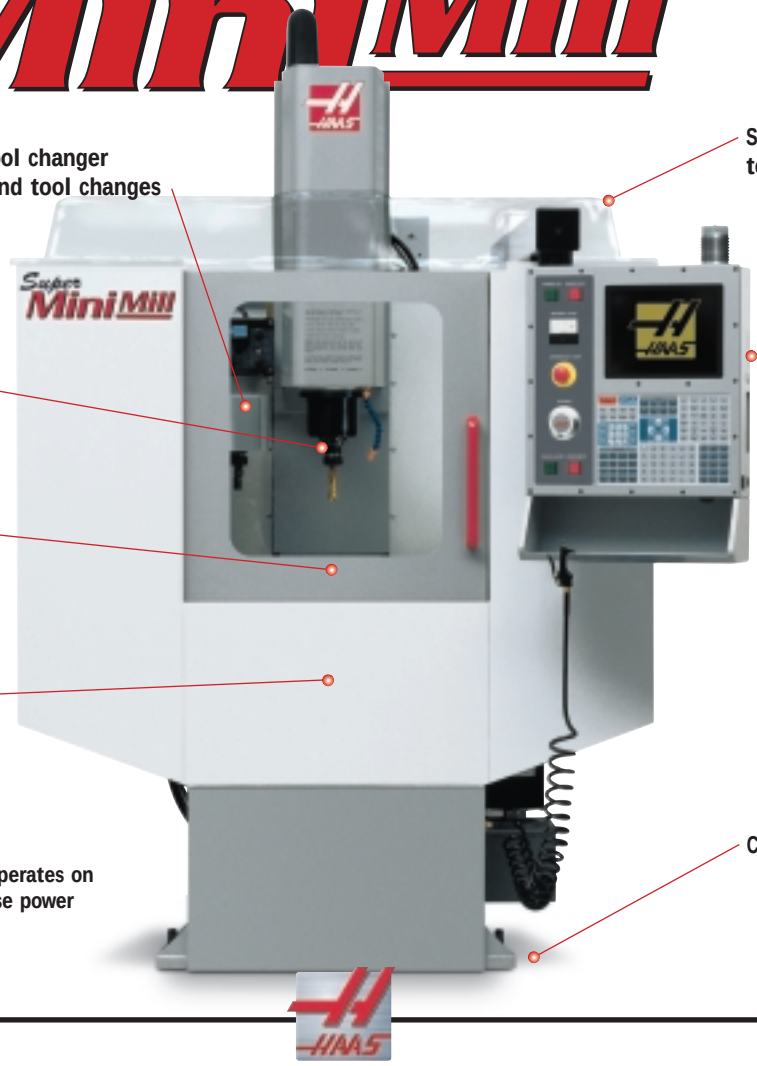


First, the Mini Mill Took the Industry by Storm . . .

Now This!

No Wonder the Competition is FREAKING OUT!

Super MiniMill



10-pocket, 40-taper tool changer features fast, 2.5-second tool changes

Standard clear plastic top cover

Vector drive spindle features 15,000 rpm and rigid tapping

Full-function Haas control features 16 MB of program memory and our High-Speed Machining option with full look-ahead

36" x 12" table handles parts up to 500 lb

The Super Mini Mill also includes the coolant pump, floppy disk drive, top cover and beacon light options

6-month warranty

High-pitch ballscrews and powerful brushless servos provide 1,200-ipm rapids

Compact 6.5' x 6.5' footprint

Machine operates on three-phase power